

## Case Report

# Recession-Resection Surgery Augmented with Botulinum Toxin A Chemodenervation for Paralytic Horizontal Strabismus

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In this case series study, we assessed the effects of recession-resection surgery augmented with botulinum toxin A chemodenervation for patients with chronic paralytic horizontal strabismus. In addition, we compared these effects with those of full tendon transposition (FTT) augmented with posterior intermuscular suture (PIMS). Ten patients who underwent strabismus surgery due to paralytic horizontal strabismus were retrospectively reviewed. They received a recession-resection surgery augmented with botulinum toxin A chemodenervation (type I surgery) or a FTT augmented with PIMS (type II surgery). The preoperative angle of deviation (AOD) and post-operative improvement in AOD were compared according to the type of procedure. The preoperative AOD was  $60.00 \pm 28.50$  prism diopters (PD) for type I surgery and  $68.00 \pm 27.06$  PD for type II ( $p = 0.421$ ). Improvement in AOD was  $53.20 \pm 25.01$  PD for type I surgery and  $44.20 \pm 18.74$  PD for type II ( $p = 0.548$ ). Recession-resection surgery augmented with botulinum toxin A chemodenervation is a concise and effective procedure for treating paralytic horizontal strabismus.

**Key Words:** Botulinum toxins type A, Paralytic strabismus, Recession-resection surgery

For chronic paralytic strabismus with large eyeball deviation, there are only a few surgical options including recession-resection surgery and muscle transposition. Given that full tendon transposition (FTT) augmented with posterior scleral fixation suture is very effective but complicated, FTT augmented with a posterior intermuscular suture (PIMS) has been suggested [1]. However, even for strabismus specialists, FTT with PIMS is somewhat complicated. We considered a recession-resection surgery reinforced with botulinum toxin A chemodenervation as another surgical option for chronic paralytic strabismus with large deviation.

Here, we compare the effects of recession-resection surgery augmented with botulinum toxin A chemodenervation with those of FTT augmented with PIMS for patients

with chronic paralytic horizontal strabismus.

## Case Reports

### Case 1

A 16-year-old man had a history of radiotherapy for astrocytoma. He had left exotropia of 80 prism diopters (PD) and left hypertropia of 10 PD. He had a loss of left adduction, and there was no midline cross. A recession-resection procedure of the horizontal recti muscles with inferior displacement was planned for the paralytic eye. A left lateral rectus recession of 14.0 mm and left medial rectus resection of 10.0 mm, combined with intraoperative injection of five units botulinum toxin A into the left lateral rectus, were performed. One year later, the patient was found to have left esotropia of 4 PD and left hypertropia of 6 PD in the primary position. No additional procedure was necessary.

### Case 2

A 58-year-old man had chronic right third cranial nerve

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**Table 1.** Characteristics of patients with recession-resection surgery augmented with botulinum toxin A chemodenervation for paralytic strabismus (type I surgery)

Patient no. / sex / age (yr)	Diagnosis	Initial deviation (PD)	Surgery	Follow-up (mon)	Final deviation (PD)
1 / M / 16	CN3, OS	80	LMR Res 10 mm + 5U BTA, LLR Rec 14 mm	12	4
2 / F / 51	CN3, OS	100	LMR Res 13 mm + 5U BTA, LLR Rec 14 mm	6	18
3 / F / 28	CN3, OS	35	LMR Res 6 mm + 5U BTA, LLR Rec 9 mm	6	12
4 / M / 58	CN3, OD	45	RMR Res 6 mm + 5U BTA, RLR Rec 11 mm	30	0
5 / M / 37	CN3, OD	40	RMR Res 6 mm + 5U BTA, RLR Rec 10 mm	6	0

PD = prism diopters; CN3 = third cranial nerve palsy; OS = oculus sinister; LMR = left medial rectus muscle; Res = resection; BTA = botulinum toxin A; LLR = left lateral rectus muscle; Rec = recession; RMR = right medial rectus muscle; RLR = right lateral rectus muscle; OD = oculus dexter.

**Table 2.** Characteristics of patients with full tendon transposition augmented with posterior intermuscular suture for paralytic strabismus (type II surgery)

Patient no. / sex / age (yr)	Diagnosis	Initial deviation (PD)	Surgery	Follow-up (mon)	Final deviation (PD)
1 / M / 32	CN6, OS	50	FTT c PIMS, OS	24	20
2 / F / 28	CN6, OS	60	FTT c PIMS, OS	6	12
3 / M / 52	CN3, OS	115	FTT c PIMS, OS	6	40
4 / F / 46	CN6, OD	50	FTT c PIMS, OD	6	12
5 / F / 47	CN6, OD	65	FTT c PIMS, OD	8	35

PD = prism diopters; CN6 = sixth cranial nerve palsy; OS = oculus sinister; FTT c PIMS = full tendon transposition with posterior intermuscular suture; CN3 = third cranial nerve palsy; OD = oculus dexter.

**Table 3.** Pre- and postoperative angles of deviation

Angle of deviation (PD)	Type I surgery <sup>*</sup>	Type II surgery <sup>†</sup>	p-value <sup>‡</sup>
Preoperative	60.00 ± 28.50	68.00 ± 27.06	0.421
Postoperative 1 wk	0.00 ± 0.00	16.25 ± 14.57	0.114
Postoperative 1 mon	0.80 ± 1.79	12.20 ± 11.58	0.222
Postoperative 6 mon	11.33 ± 7.02	19.00 ± 1.41	0.200
At final follow-up	6.80 ± 7.95	23.80 ± 13.05	0.056
Final improvement	53.20 ± 25.01	44.20 ± 18.74	0.548

PD = prism diopters.

<sup>\*</sup>Recession-resection surgery augmented with botulinum toxin A chemodenervation; <sup>†</sup>Full tendon transposition augmented with posterior intermuscular suture; <sup>‡</sup>Mann-Whitney U-test.

palsy caused by a pituitary gland tumor. A dilated, fixed pupil was observed in his right eye. He had right exotropia of 45 PD and right hypertropia of 4 PD. Right lateral rectus recession of 11.0 mm and right medial rectus resection of 6.0 mm with inferior displacement, combined with intraoperative injection of 5 units botulinum toxin A into the right lateral rectus, were performed. At a 30-month follow-up, the alignment was nearly straight in the primary position at near and far distances.

We retrospectively reviewed the medical records of five patients who received a recession-resection surgery aug-

mented with botulinum toxin A chemodenervation (type I surgery) from January 1998 to December 2007. These patients had third cranial nerve palsy with exotropia. All surgical procedures were performed by a strabismus specialist, and the same investigator obtained all the pre- and postoperative data. During surgery, five units of botulinum toxin A (Botox; Allergan Inc., Irvine, CA, USA) in 0.1 mL of saline solution was injected into the recessed horizontal rectus muscle after conventional recession-resection. The injection was administered slowly under direct visualization.

We compared the results with those of FTT augmented with PIMS (type II surgery). According to the type of procedure, the pre- and postoperative angles of deviation (AOD) were compared.

Tables 1 and 2 provide a summary of the patient characteristics. The mean ages of the type I and type II surgery groups were  $38.00 \pm 16.99$  years and  $41.00 \pm 10.39$  years (range, 16 to 58 years), respectively. The mean follow-up time for all patients was  $11.00 \pm 8.76$  months (range, 6 to 30 months).

The data on pre- and postoperative AOD are shown at Table 3. The mean preoperative AOD was  $60.00 \pm 28.50$  PD (type I surgery) and  $68.00 \pm 27.06$  PD (type II surgery) ( $p = 0.421$ ). At preoperative and postoperative 1 week, 1 and 6 months, and the final follow-up, the AODs were not significantly different. In addition, the final improvement in AOD was  $53.20 \pm 25.01$  PD (type I surgery) and  $44.20 \pm 18.74$  PD (type II surgery) ( $p = 0.548$ ). There were no complications such as a scleral perforation, anterior segment ischemia, or ptosis in any of the cases during the surgical procedure or in the postoperative follow-up period. All statistical analyses including the Mann-Whitney *U*-test were performed with SPSS ver. 15.0 (SPSS Inc. Chicago, IL, USA).

## Discussion

The surgical goal for chronic paralytic strabismus is to center the field of single binocular vision and to align the eyeballs in primary and down-gaze positions. Although the surgical choice usually depends on the amount of residual muscle function, a large recession-resection surgery or transposition of recti muscles may be selected.

Previously, Ozkan et al. [2] reported the effect of intraoperative botulinum toxin A injection combined with conventional horizontal recti muscle surgery in ten patients with infantile esotropia, nonrefractive accommodative esotropia, partial accommodative esotropia, basic esotropia, basic exotropia, and sensory exotropia.

According to neurophysiological studies, botulinum toxin A applied to the periphery could directly affect central circuits via retrograde transport [3]. In addition to preventing muscle contracture, botulinum toxin A injection causes permanent alteration in the muscle and influences the peripheral and central nervous systems. Kranjc et al. [4] studied the long-term changes of extraocular muscles after botulinum toxin A injection into the medial rectus muscles

of adult rats. These changes occurring in the horizontal rectus muscles after botulinum toxin A chemodenervation may be responsible for the permanent additive effect of botulinum toxin A.

In our cases, the patients had large exotropia with chronic third cranial nerve palsy. There was a loss of adduction and no midline cross. We performed simple recession-resection surgery accompanied by intraoperative botulinum toxin A chemodenervation. Our results show that a recession-resection surgery augmented with botulinum toxin A chemodenervation had a similar effect to that of FTT augmented with PIMS. Even though FTT augmented with PIMS is relatively simple and safe compared to other surgeries for chronic paralytic strabismus with large deviation, it may be technically more difficult than a recession-resection surgery. Thus, our recession-resection surgery augmented with botulinum toxin A chemodenervation technique is a good surgical option. However, due to the small number of patients, the present study has limited statistical validity. Well-designed prospective studies are needed to compare botulinum toxin A treatment to standard surgical management.

In conclusion, the recession-resection surgery augmented with botulinum toxin A chemodenervation is as effective as FTT augmented with PIMS for treating paralytic horizontal strabismus.

## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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